421824

FLOOD INSURANCE STUDY

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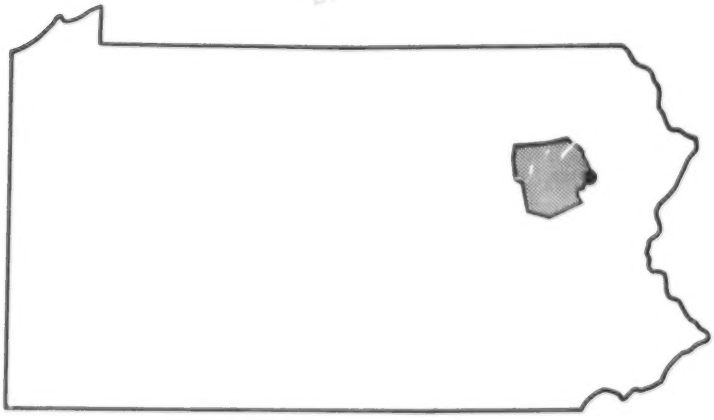
TOWNSHIP OF BUCK, PENNSYLVANIA
LUZERNE COUNTY



OCTOBER 15, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 421824

FEMI.299

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY
TOWNSHIP OF BUCK, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Buck, Luzerne County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Buck to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Gilbert Associates, Inc., for the Federal Insurance Administration, under Contract No. H-4817. This study was completed in August 1979.

1.3 Coordination

A legal notice announcing the beginning of the study and its objectives was placed in the local newspaper for a period of two weeks.

Streams requiring detailed study were identified on May 17, 1979, at the initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of the study contractor, the FIA, and the Township of Buck.

A search for basic information was made at all levels of government and the private sector. Contacts were made with the U. S. Geological Survey (USGS); the Pennsylvania Department of Environmental Resources, Research Programming; the Pennsylvania Department of Transportation, Photogrammetry Laboratory; the U. S. Army Corps of Engineers (COE); the Luzerne County Conservation District; the Luzerne County Planning Commission; and the Board of Supervisors of the Township of Buck.

On April 23, 1980, the results of the study were reviewed at the final CCO meeting attended by representatives of the study contractor, the FIA, and community officials.

2.0 AREA STUDIED

2.1 Scope of Study

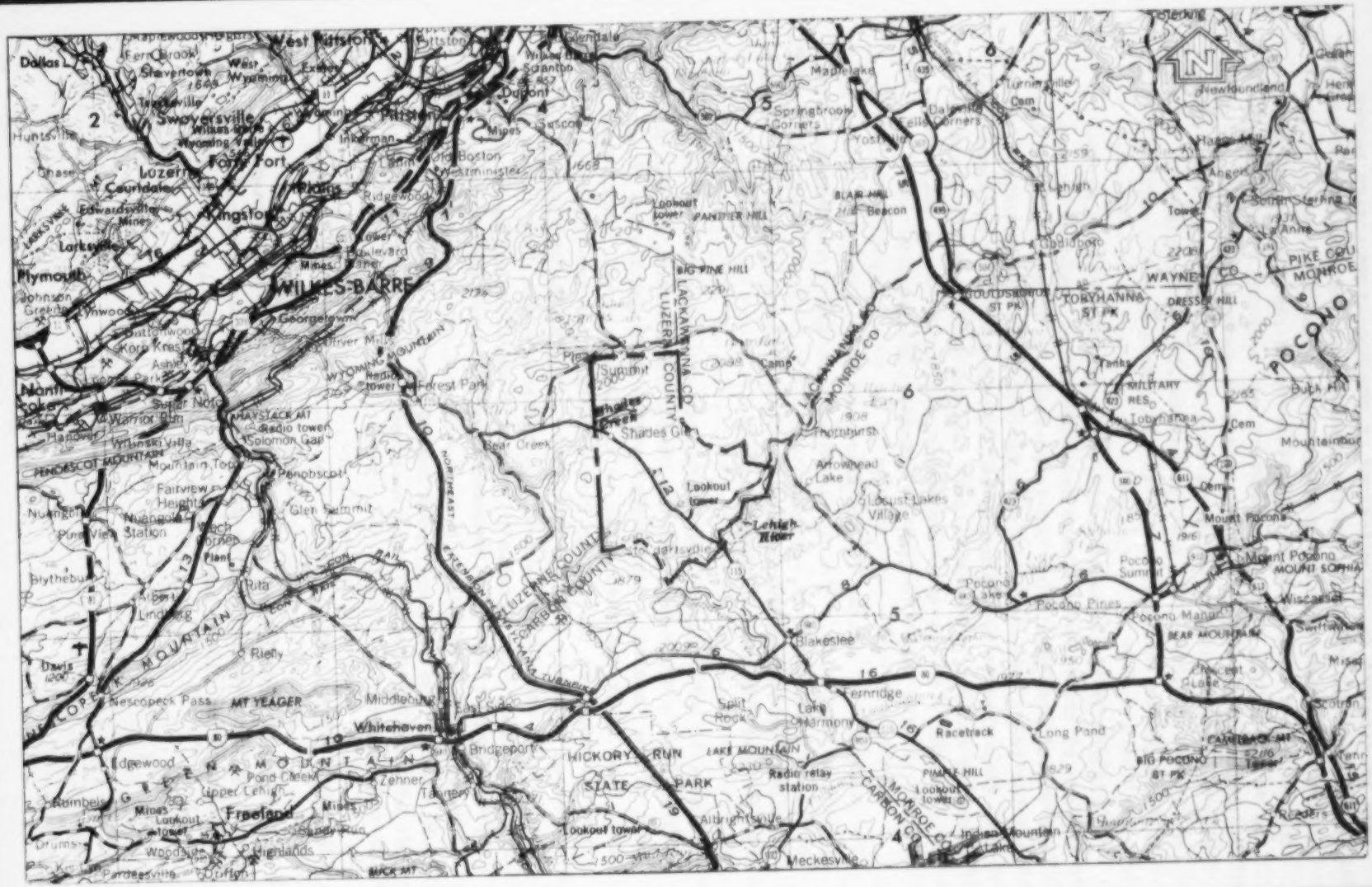
This Flood Insurance Study covers the incorporated area of the Township of Buck, Luzerne County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1). State Game Lands No. 91 was not studied.

A detailed study was performed on the Lehigh River from approximately 0.7 mile downstream of the Pennsylvania Route 115 bridge over the Lehigh River to the confluence with Choke Creek approximately 4.1 miles upstream of the bridge. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through August 1984.

Studied by approximate methods were Shades Creek, Choke Creek, Kendall Creek and the remaining portion of the Lehigh River. Approximate methods of analysis were used to study those areas having low development potential and minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by the FIA.

2.2 Community Description

The Township of Buck is located in east-central Luzerne County in northeastern Pennsylvania. Approximately 14 miles northwest of Buck is the City of Wilkes-Barre. The Township of Buck is bounded to the west and north by the Township of Bear Creek, Luzerne County; to the east by the Township of Lehigh, Lackawanna County, and the Township of Tobyhanna, Monroe County; and to the south by the Township of Kidder, Carbon County.


WILKES-BARRE
Dallas
Shavertown
Swoyersville
Forty Fort
Luzerne
Courtdale
Kingston
Larksville
Plymouth
West Pittston
Pittston
Duryea
Dupont
Avoca
Inkerman
Pittston
Wyoming
Exeter
West Wyoming
Maplelake
Springbrook Corners
Dalton
Lehigh
Tobyhanna
Mountainhome
Mount Pocono
Pocono Pines
Pocono Manor
Blakeslee
Lehighton
Jim Thorpe
Nescopeck Pass
MT YEAGER
Whitehaven
Bridgeport
Middleburg
Freeland
Hazleton
Meckesville
Riefly
Davis
Rita
Lindberg
Blythebu
Nuangola
Pine View
Penobscot
Glen Summit
Fairview Heights
Warrior Run
Sugar Notch
Hanover
Wilkinsville
Mountain Top
Forest Park
Radio tower
Solomon Gap
Shades Glen
Bear Creek
Thornhurst
Arrowhead Lake
Locust Lakes Village
Lookout tower
Lehigh River
Summit
Camp
Pleasant
Thaxter Creek
Lookout Tower
PANTHER HILL
BIG PINE HILL
BLAIR HILL
Beacon
Radio relay station
LAKE MOUNTAIN
HICKORY RUN
STATE PARK
Split Rock
Lake Harmony
Racetrack
Long Pond
PIMPLE HILL
Lookout tower
Indian Mountain
CAMELBACK MT
BIG POCONO ST PK
TOBYHANNA ST PK
POCONO MOUNTAIN
BUCK MT
Pondcreek
Upper Lehigh
Zehner
Tarkeys
Woodside
Drifton
Harveys Lake
Ceasetown
Newfoundland
Turnerville
Cem
Angola
Towne
Lehigh
Scranton
Wilkes-Barre
Dupont
Avoca
Dallas
Shavertown
Swoyersville
Forty Fort
Luzerne
Courtdale
Kingston
Larksville
Plymouth
Nanticoke
Hanover
Wilkinsville
Mountain Top
Penobscot
Nuangola
Pine View
Blythebu
Davis
Riefly
Rita
Lindberg
Fairview Heights
Glen Summit
Warrior Run
Sugar Notch

Buck is situated on the outskirts of the Pocono Mountains resort area. The 16.9 square miles the township encompasses are 90 percent forested (Reference 1). The township is presently experiencing a change from a rural community of year-round residents to a suburban and vacation home area for commuters and seasonal residents. Many of the homes in the area are seasonal or second homes and are generally clustered in small villages such as Indian Lake, Shades Glen and Stoddartsville. Its population was 256 in 1960, 294 in 1970 and is expected to increase to 335 in 1980 (References 2 and 3).

The climate in the area is humid continental, modified by the effects of the Atlantic Ocean and the Gulf of Mexico. Because of the surrounding mountains the temperature is relatively cool throughout the year. The mean temperature is 48 degrees Fahrenheit (°F) with temperatures occasionally rising above 90°F in the summer and dropping below 0°F in the winter. Annual precipitation averages 37.2 inches with the greatest amount falling in June, July and August and the least falling in January and February.

The township is located in the Ridge and Valley Province of the Appalachian Mountains. The topography is generally mountainous, with elevations ranging from approximately 1,500 to 2,000 feet. The most prominent geological feature is Dry Land hill located in the south-central portion of the township.

Drainage is generally to the south into the Lehigh River, although Indian Lake's drainage is to the west. Indian Lake, in the northern part of the township, drains through Shades Creek before flowing into Bear Creek and eventually to the Lehigh River. Choke Creek, from its mouth at the Lehigh River, forms a portion of the township's northeast boundary. The Lehigh River, flowing through a steep gorge, also forms a portion of the township's boundary to the south and southeast. The Francis E. Walter Flood Control Dam is situated approximately three miles downstream of the southwest corner of the township, just downstream of the confluence of the Lehigh River and Bear Creek. The reservoir pool behind the dam is normally small, but at times of flooding, the reservoir could extend as far upstream as Stoddartsville.

2.3 Principal Flood Problems

The past history of flooding on the streams within the Township of Buck indicates that flooding may occur during any month of the year although major floods have occurred more frequently during February,

March, April, and May. These floods are usually the result of spring rains, snowmelt or a combination of both. Storms occurring during the early summer months are often associated with tropical storms moving up the Atlantic coastline.

The Lehigh River is the primary source of flooding in the township. However, flood damage has been minimal because of the undeveloped nature of the township along the river and the deep valley the river flows through. The most serious flood on record was due to Hurricanes Connie and Diane in August 1955, with a peak flow rate of 31,900 cubic feet per second (cfs) at Stoddartsville and a recurrence interval of approximately 200 years (Reference 4). Other storms which caused flooding occurred in May 1942 and December 1950, with peak flows of 15,700 cfs and 7,250 cfs, and recurrence intervals of 40 and 10 years, respectively. Tropical Storm Agnes, in June 1972, was much less severe in the upper Lehigh River drainage basin than in the adjoining Susquehanna River basin. At Stoddartsville, Tropical Storm Agnes produced a peak flow rate of only 3,210 cfs, with a recurrence interval of approximately three years.

2.4 Flood Protection Measures

There are no existing or planned flood protection projects or structures to reduce flooding hazards in the township. However, nonstructural measures of flood protection are being utilized. These measures are in the form of land-use regulations adopted from the Code of Federal Regulations which controls building within areas that have a high risk of flooding.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals

or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail affecting the community.

The peak discharges for the Lehigh River, used in this study, provided by the USGS, were determined from log-Pearson Type III flood frequency curves adjusted by the Water Resources Commission for gage station 4475 located near Stoddartsville (Reference 4). This gage is located 75 feet upstream of Pennsylvania Route 115. Stage discharge records for this gage for the period from 1942 through 1977 were used in this analysis.

A summary of drainage area-peak discharge relationships for the stream studied in detail is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LEHIGH RIVER					
At USGS Gaging Station No. 4475, Stoddartsville, Pennsylvania	91.7	7,314	16,607	22,676	44,156

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding source studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along this flooding source.

Water-surface profiles of floods of the selected recurrence intervals were computed through the use of the COE HEC-2 step-backwater computer program (Reference 5). The starting water-surface elevations for the Lehigh River were determined using the slope/area option in the HEC-2 computer program to compute normal depth for the first cross section, located 1,200 feet downstream of the corporate boundary.

Cross sections for the backwater analyses of the flooding source studied in detail were field surveyed. Cross sections were located at close intervals above and below bridges, culverts and other hydraulic structures, in order to compute the significant backwater effects from these structures.

Channel roughness factors (Manning's "n) for these computations were assigned on the basis of field inspection of flood plain areas, and were based on channel conditions and overbank land uses. The values chosen were compared with recognized standard texts for reasonableness (References 6 and 7). The hydraulic models were tested and the "n" values adjusted within an acceptable range to best fit the Stoddartsville gage station rating curve. When a satisfactory model was achieved, the water-surface profiles were computed for the 10-, 50-, 100-, and 500-year floods. The "n" values for the Lehigh River were 0.042 for the channel, and 0.110 for the overbanks. The high overbank value is due to the heavily wooded area which exists along the reaches in the study area.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:12,000 with a contour interval of 20 feet (Reference 8). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

For the streams studied by approximate methods, the boundary of the 100-year flood was adopted directly from existing Flood Hazard Boundary Maps (Reference 9).

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent

flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this report is presented to local agencies as a minimum standard that can be adopted or that can be used as a basis for additional studies.

The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. The Lehigh River forms the southeastern boundary of the township. A portion of the floodway is, therefore, outside the corporate limits.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for the flooding source affecting the Township of Buck.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Lehigh River								
A	24,400	286	3,808	6.0	1,453.4	1,453.4	1,453.9	0.5
B	26,275	170	2,249	10.1	1,458.2	1,458.2	1,458.8	0.6
C	27,225	200	2,441	9.3	1,477.9	1,477.9	1,478.1	0.2
D	28,275	380	3,417	6.6	1,481.7	1,481.7	1,482.0	0.3
E	29,725	382	5,517	4.1	1,483.6	1,483.6	1,484.1	0.5
F	31,750	624	7,557	3.0	1,485.0	1,485.0	1,486.0	1.0
G	33,400	561	4,989	4.5	1,486.7	1,486.7	1,487.7	1.0
H	35,325	556	5,822	3.9	1,490.8	1,490.8	1,491.0	0.2
I	37,800	624	6,104	3.7	1,493.5	1,493.5	1,494.1	0.6
J	38,700	576	4,990	4.5	1,494.5	1,494.5	1,495.2	0.7
K	40,300	600	5,541	4.1	1,498.4	1,498.4	1,499.0	0.6
L	41,350	384	4,332	5.2	1,500.0	1,500.0	1,501.0	1.0
M	43,100	418	5,154	4.4	1,503.3	1,503.3	1,503.9	0.6
N	44,900	500	4,389	5.2	1,506.7	1,506.7	1,507.7	1.0

[1] Feet above corporate limits

[2] This width extends beyond corporate limits

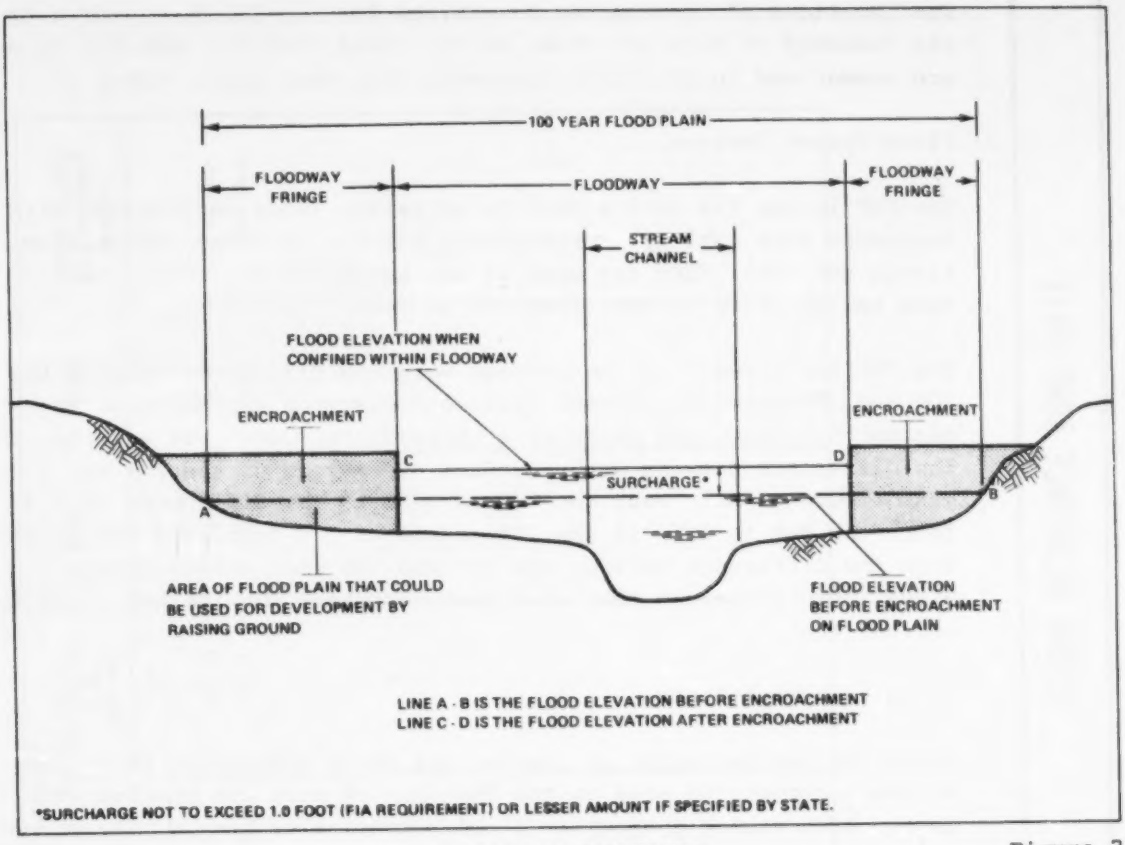
TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF BUCK, PA
(LUZERNE CO.)

FLOODWAY DATA

LEHIGH RIVER


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding source of the Township of Buck are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Township of Buck was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A12, A16:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Lehigh River							
Reach 1	05	-8.2	-2.7	+7.9	080	A16	Varies
Reach 2	05	-5.8	-1.9	+5.5	060	A12	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF BUCK, PA
(LUZERNE CO.)

FLOOD INSURANCE ZONE DATA

LEHIGH RIVER

Zone B: (continued)		types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:		Areas of minimal flooding.
Zone D:		Areas of undetermined, but possible flood hazards.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Buck is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

The Flood Insurance Study for the Township of Bear Creek was published in September 1978 (Reference 10). No other reports relating to flooding problems relevant to the Township of Buck were found to exist at the time of this report. The results of this study and the Bear Creek study are in exact agreement.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this report can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

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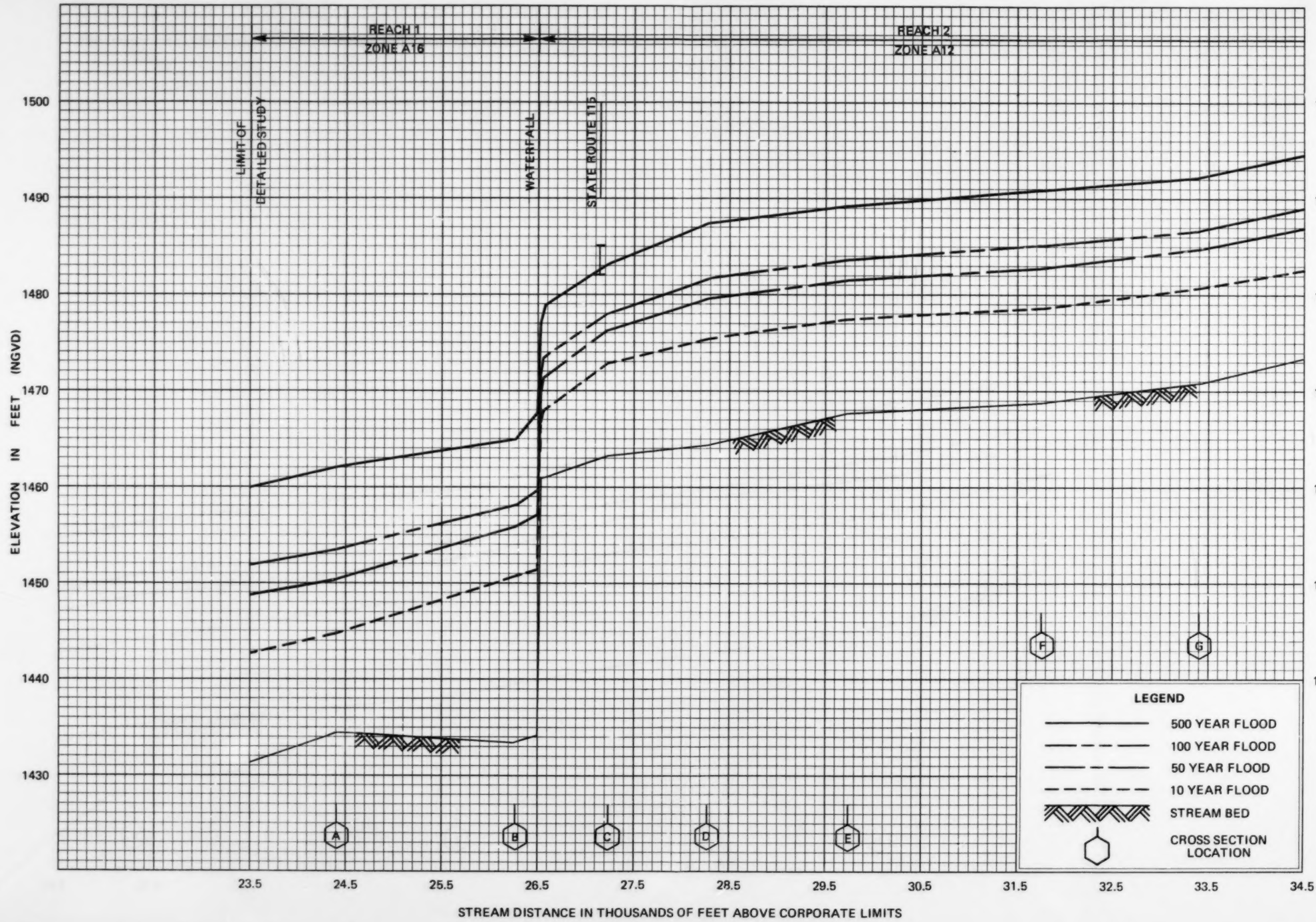

FLOOD PROFILES

LEHIGH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF BUCK, PA
(LUZERNE CO.)

01P

REACH 2
ZONE A12

LIMIT OF DETAILED STUDY

ELEVATION IN FEET (NGVD)

1520
1510
1500
1490
1480
1470

34.5 35.5 36.5 37.5 38.5 39.5 40.5 41.5 42.5 43.5 44.5 45.5

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CORPORATE LIMITS

H I J K L M N

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

best copy available

FLOOD PROFILES

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02P